Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **2012**	2. REPORT TYPE	3. DATES COVERED **00-00-2012 to 00-00-2012**

4. TITLE AND SUBTITLE **How traffic engineering can solve the problem of circuit saturation**	5a. CONTRACT NUMBER
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Army Signal Center of Excellence,Army Communicator,Signal Towers (Building 29808), Room 713,Fort Gordon,GA,30905-5301**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR’S ACRONYM(S)
	11. SPONSOR/MONITOR’S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**2**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

How traffic engineering can solve the problem of circuit saturation

By CPT Felix Torres

The dynamics of U.S. military communications in the Afghanistan Theater has changed dramatically over the last few years.

There have been significant upgrades in bandwidth from the typical 8 Mbps satellite circuits to 10 Gbps fiber optic metropolitan area network solutions. The capability to support increased customer requirements and efficiency provided by Internet Protocol based transport were the initial drivers to facilitate a migration from legacy Time Division Multiplexers (e.g. Promina) to the IP based infrastructure found in the Afghanistan Black Core Network today.

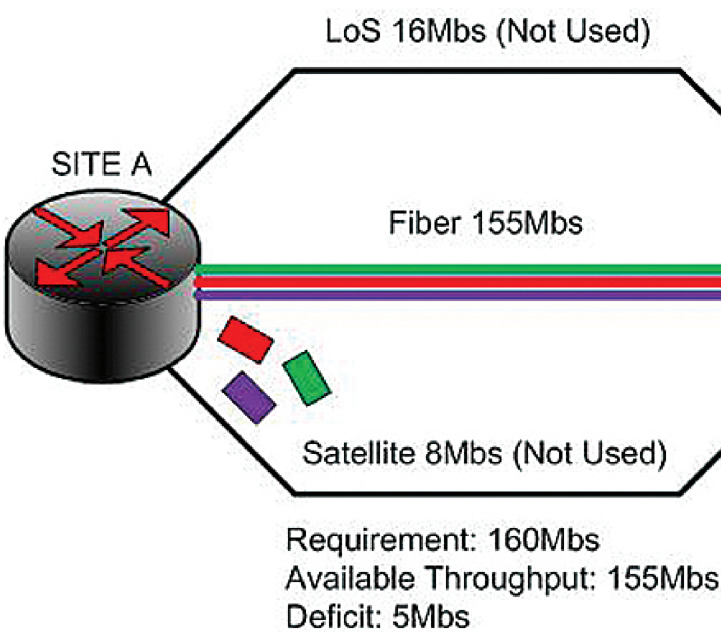
An additional advantage of leveraging IP transport is the ability to dynamically provision bandwidth to all traffic traversing the network as their bandwidth requirements fluctuate.

The Black Core Network was introduced into production in early 2010 and modeled after the Defense Information System Agency backbone infrastructure. The BCN in Afghanistan continues to grow and mature as the primary method of transporting secure communications. The introduction of Multiprotocol Label Switching to the BCN allowed for each customer's traffic to be isolated into its own virtual circuit. Separation of customer traffic is made possible by maintaining a separate routing table on the BCN for each virtual circuit. Improvements in hardware and routing protocols have enabled multiple concurrent means of transport on the battlefield that previously were limited to large strategic entities such as DISA.

In certain parts of Afghanistan, mission critical traffic has to compete for bandwidth on congested links. In the aggregate, throughput requirements exceeded allocated bandwidth.

Even though there are other paths available on the BCN, standard routing techniques required all traffic, including Secure Internet Protocol Routing, Non-Secure Internet Protocol Routing, and coalition partner networks to transit through a single primary path. As the BCN transport system grew to include additional customers outside of NIPR, SIPR & CX-I, the need to prioritize traffic based upon operational impact began to emerge.

Despite the fact that Black Core routing allowed for the dynamic provisioning of bandwidth for SIPR/NIPR/CX-I based on need, this may not be enough as traffic separation becomes a priority as well.



To overcome the limitations imposed by standard IP routing techniques, network engineers in Afghanistan began employing Multi Protocol Label Switching "Traffic Engineering."

Traffic Engineering allows for the routing of data across multiple transmission media concurrently. Where previously, standard routing protocol may only allow the

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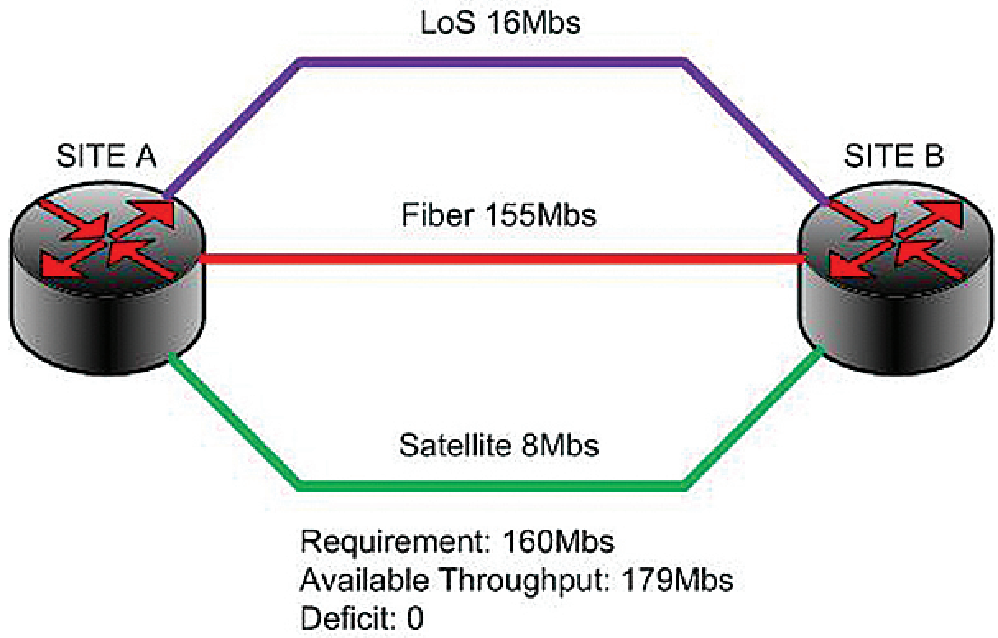

transmission of data over a single fiber path, Traffic Engineering can enable the transmission of data across fiber and satellite links at the same time. For example, by using Traffic Engineering, if it became necessary, network engineers can provision mission critical SIPR/ CX-I over low-latency fiber paths between sites, while directing non-critical NIPR over high-latency satellite links.

The BCN uses many different modes of transmission including fiber optic, commercial and military Line of Sight radios and different bands of satellite terminals. Figure 1 shows how normal routing would occur for NIPR, SIPR and CX-I traffic.

MPLS-TE enables the use of all links between a Forward Operating Base or Combat Outpost and its hub. For example, MPLS-TE makes it possible to concurrently use a 155Mbps fiber path, an 8Mbps satellite link and a 16Mbps Line of Sight shot between Site A to the regional hub at Site B. This is accomplished by routing traffic for one enclave (e.g. SIPR) over a commercial LoS link, traffic for another enclave (e.g. CX-I) over a fiber optic link and traffic for another enclave (e.g. NIPR) over a commercial satellite link, as illustrated in Figure 2.

This results in a substantial return on investment by allowing operational forces to take advantage of multiple links and providing failover in outage situations. It also allows mission critical traffic to be routed over higher speed links, as in the example above.

The Afghan BCN continues to evolve in its development and now exists at over 70 sites within the Combined Joint Operation Area –Afghanistan. An argument could be made that the ingenuity of the BCN engineering team in leveraging technology such as MPLS-TE has saved the Department of Defense countless dollars in recurring monthly service provider charges and capital equipment expenditures while exemplifying the intelligent application of technology to solve problems on the battle field.

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Acronym QuickScan

BCN – Black Core Network
CENTRIXS-ISAF, CX-I - Combined Enterprise Regional Information Exchange System - International Security Assistance Force
COP - Combat Outpost
DISA - Defense Information System Agency
FOB - Forward Operating Base
Gbps – Gig bits per second
IP – Internet Protocol
LoS - Line of Sight
Mbps – Mega bits per second
MPLS - Multiprotocol Label Switching
MPLS-TE - Multi Protocol Label Switching Traffic Engineering
NIPR - Non-Secure Internet Protocol Routing
SIPR - Secure Internet Protocol Routing